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Gold in Bubble Memories

Bubble memories are microelectronic serial-access information devices in which data from a storage film of garnet are carried as microscopic domains of magnetic polarization in a separate drive layer of garnet grown epitaxially on the storage layer. These domains appear as bubble-like discs when viewed with polarized light. A new type of device, which is currently being developed, utilizes gold films in the movement of information bubbles.

Existing information storage devices, in which magnetic bubbles are carried by travelling potential wells in Permalloy chevron-elements, presently offer a storage density of about 1 million bits (Mb) per square centimetre with a possibility of achieving 1.5 Mb/cm^2. This, however, would strain the capabilities of the photo-lithographic technology used in the manufacture of the devices, due to the very high resolution required to produce parts of the circuit pattern which should have dimensions of a fraction of the bubble diameter — for example, sub-micrometre dimensions in the case of a 1 μm bubble.

A recent article (*IEEE Spectrum*, 1981, **18**, (2), 30-34) by S. Lin and I. L. Saunders, of IBM San Jose Research Laboratory, discusses the possible replacement of the current technology with a new generation of contiguous-element magnetic bubble devices in which the elements are undulating gold deposits. Devices in development at present have a storage density of 4 Mb/cm^2, and 16 Mb/cm^2 appears within reach with standard production methods.

In the proposed contiguous-disc bubble circuitry, Permalloy propagation patterns are not involved and the bubbles are moved not under the circuit pattern, but alongside it. Thus, lithographic features greater than the bubble diameter are permitted, yielding possible storage densities of 4 Mb/cm^2 for 1 μm bubbles and 16 Mb/cm^2 for 0.5 μm bubbles.

In these contiguous-disc devices, the gold circuit pattern acts primarily as a mask for ion implantation to alter the magnetic characteristics of the surface garnet layer. The gold patterns may also carry the currents that provide the magnetic fields for such functions as bubble generation and switching. The flow of magnetization within the garnet, resulting from an applied magnetic field which is forced into the plane of the drive layer as a result of ion implantation of the structure, bends around the gold discs — more accurately diamonds or triangles — like the flow of a river around islands, forming diverging and converging charged walls which attract the memory bubbles and carry them along as the walls rotate with the in-plane magnetic field. This behaviour was depicted by Lin and Saunders in the diagram shown below. C.L.